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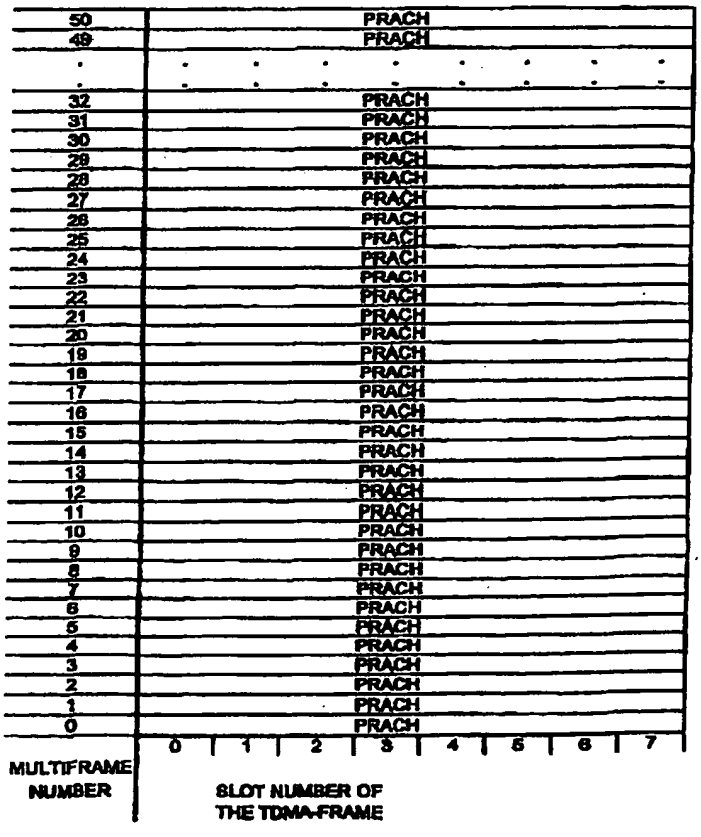
(54) Title: SDMA PACKET RADIO SYSTEM AND CHANNEL ESTABLISHMENT METHOD

(57) Abstract

The invention relates to a packet radio system and a method using SDMA for channel establishment. The packet radio system comprises a network part (100), at least one subscriber terminal (102) and a duplex radio connection (104) between the network part (100) and a subscriber terminal (102). The duplex radio connection (104) is used for connection set–up and packet transmission. The invention is characterized in that for connection set–up the network part (100) and the subscriber terminal (102) are arranged to establish a special channel (210) with a significantly longer range than that of a normal channel (200). The special channel (210) has a bit energy–to–noise ratio of about 5–12 dB better than the normal channel (200).



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SDMA PACKET RADIO SYSTEM AND CHANNEL ESTABLISHMENT METHOD

FIELD OF THE INVENTION

The invention relates to a packet radio system using SDMA, said system comprising a network part, at least one subscriber terminal and a duplex radio connection between the network part and a subscriber terminal, said duplex radio connection being used for connection set-up and packet transmission.

BACKGROUND OF THE INVENTION

Packet radio system refers to a radio system using packet switching technique known from fixed networks. It is the opposite of a circuit-switched radio system. Circuit switching is a method where a connection between users is set up by allocating for the connection a predetermined amount of transmission capacity. The transmission capacity is exclusively available to said radio connection during the whole duration of the connection. Known radio systems, such as GSM-based GSM 900/DCS 1800/PCS 1900 systems and the US radio system utilizing the CDMA technique are thus circuit-switched. Packet switching is a method where a connection is set up between users by transmitting data in packets comprising address and control data. Several connections can use the same transmission connection simultaneously. During recent years the use of packet switched radio systems particularly for data transmission has been a subject of research, because packet switching is well-suited e.g. to the data transmission needed by computer programs, where the data to be transmitted is generated in bursts. In this case the data transmission connection does not need to be occupied all the time but only during the transfer of the packets. This significantly saves costs and capacity both when a network is being built and used.

The research on packet radio networks was started at the University of Hawaii in 1968 with an ALOHA project in which a mainframe computer was connected to remote terminals by means of a radio connection. Today packet radio networks are an object of a particular interest in the further development of the GSM system, which in this connection is referred to as the General Packet Radio Service (GPRS). For instance, an ETSI GSM specification (ETSI GSM 03.64) describes an air interface between a network part and a subscriber terminal in the GPRS.

In the GSM system one physical channel is one time slot of a TDMA frame. Logical channels are common channels or dedicated channels. A TDMA frame comprises 8 time slots. For dedicated channels has been defined a 26 TDMA frames long 26-multiframe, using time slots 1 - 7 of the TDMA frame. For common channels has correspondingly been defined a 51 TDMA frames long 51-multiframe, using time slot 0 of the TDMA frame. The common channels comprise Broadcast Channels (BCH) and Common Control Channels (CCCH). The BCH channels comprise a Frequency Correction Channel (FCCH), a Synchronization Channel (SCH) and Broadcast Control Channels (BCCH). The CCCH channels comprise a Paging Channel (PCH), an Access Grant Channel (AGCH) and Random Access Channels (RACH). The dedicated channels comprise Traffic Channels (TCH) and Dedicated Control Channels (DCH). The DCH channels comprise a Stand-alone Dedicated Control Channel (SDCCH), a Slow Associated Control Channel (SACCH) and a Fast Associated Control Channel (FACCH).

In accordance with the earlier mentioned ETSI GSM specification 03.64, in a packet radio system is defined one physical channel, a Packet Data Channel (PDCH), for connection set-up and packet transmission, said channel being in practice a traffic channel. Into the PDCH channel are then arranged logical channels. Logical channels are divided into Packet Common Control Channels (PCCCH) and packet traffic channels. The packet traffic channels comprise Packet Data Traffic Channels (PDTCH) and Packet Associated Control Channels (PACCH). PCCCH channels comprise Packet Random Access Channels (PRACH), Packet Paging Channels (PPCH), Packet Access Grant Channels (PAGCH) and Packet Broadcast Control Channels (PBCCH).

In this description calling channels refer to those channels which are needed in the packet radio system in operations associated with connection set-up and set-down, such as calling a subscriber terminal, reserving a channel, etc. For instance in a conventional GSM system these channels are PCH and AGCH channels in a downlink connection and RACH channels in an uplink connection. In a GSM system using a packet radio system the corresponding channels are PPCH and PAGCH channels in a downlink connection and PRACH channels in an uplink connection.

The SDMA (Space Division Multiple Access) technology is used to increase the coverage area of dedicated channels in a radio system. This is

implemented by using intelligent antenna solutions, whereby a directional antenna beam has been allocated to the connection of an individual user. The directing of an antenna beam is performed either physically by moving the antenna to be directed or electronically by changing the radiation pattern of the antenna. The biggest problem is that at the time of the connection set-up, the location of the subscriber terminal is not known and so the antenna beam cannot be directed. In normal radio systems one way of solving this problem has been to increase the transmission power of the common channels needed at the time of connection set-up. This solution causes new problems because it is expensive and technically complicated to implement. In addition, the solution does not function in a GSM system utilizing the GPRS, because GSM uses normal traffic channels also for transmitting common channels. Another known solution is even worse: trusting that common channels will function below a predetermined level of sensitivity. This greatly impairs the operation of the system and the reliability of its operation. In packet radio systems no well-functioning system has been developed yet.

CHARACTERISTICS OF THE INVENTION

An object of the present invention is thus to provide a packet radio system which allows efficient use of the SDMA, avoiding the above mentioned problems.

This is achieved with a system described in the preamble, which is characterized in that for connection set-up a network part is arranged to establish a special channel with a significantly longer range than that of a normal channel.

The invention also relates to a system described in the preamble, said system being characterized in that for connection set-up a subscriber terminal is arranged to establish a special channel with a significantly longer range than that of a normal channel.

The invention further relates to a method for establishing a channel in a packet radio system using the SDMA, said packet radio system comprising a network part, at least one subscriber terminal and a duplex radio connection between the network part and a subscriber terminal, said duplex radio connection being used for connection set-up and packet transmission.

The method is characterized in that the method comprises a step:

A) for connection set-up a special channel is established with a significantly

longer range than that of a normal channel.

A system of the invention offers various significant advantages. As the use of the SDMA technology becomes possible, the increasing of the coverage area of cells by means of directional antennas can be fully utilized. The payload bit energy-to-noise ratio of a transmitted calling channel improves significantly. This is due, e.g. in the case of a narrowband special channel, to the payload bit energy-to-noise ratio being inversely proportional to the bit rate of a transmission, when transmission power remains constant. This increases the coverage area of a base station significantly. The solution is technically easy to implement, both to a network part and to a user terminal, and it does not increase the costs of equipment manufacturing as new components are not needed.

A method of the invention provides the same advantages as the above described system. It is apparent that preferred embodiments and detailed embodiments can be interconnected to produce different combinations in order to achieve the desired technical efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is now described in more detail with reference to the examples shown in the attached drawings, in which

Figure 1 illustrates a packet radio system,

Figure 2 illustrates a normal carrier and an example of a carrier including special channels,

Figure 3 illustrates an example of normal channels for an uplink connection,

Figure 4 illustrates an example of special channels for an uplink connection,

Figure 5 illustrates an implementation of a system.

DESCRIPTION OF PREFFED EMBODIMENTS

Let us examine Figure 1. A radio system comprises a network part 100 and a subscriber terminal 102, with an intermediate duplex radio connection 104. The radio connection 104 is used to transmit at a predetermined carrier frequency a radio signal into which a frame structure is arranged. In a GSM system a frame comprises time slots. In each time slot is arranged either a common channel or a dedicated channel.

In accordance with the invention, the network part 100 and the

subscriber terminal 102 are arranged to establish a special channel for connection set-up. The range of the special channel is significantly longer than that of a normal channel. The channel has a bit energy-to-noise ratio of about 5 - 12 dB better than a normal channel. Let us now examine Figure 2, which illustrates an example of a part of a frequency range for a downlink connection in the GSM system. The distance between the middle points of the carrier frequencies is 200 kHz. The X axis shows three channels of 935.2 MHz, 935.4 MHz and 935.6 MHz respectively. The Y axis shows the transmission power. The wave forms 200, 202 illustrate normal channels used for packet transmission. The wave form 210 illustrates how a frequency band of 200 kHz normally comprising one channel is narrowed to a width of 25 kHz. It is thus narrowed at a ratio of 1:8. Narrowing can be performed at ratios varying between 1:3 - 1:16. Since the capacity of the channel reduces, more time slots are needed for transmitting a particular amount of information. The amount of information to be transmitted is therefore also reduced, the data transmission capacity being only about 1/16 - 1/3 of the data transmission capacity of a normal channel. A special channel should preferably not be used for transmitting other than data needed for connection set-up. In other words, after connection set-up a normal channel is used for packet transmission. This allows using a directional antenna beam, because then the subscriber terminal is at a known location in relation to a base station. Another way of implementing packet transmission is to perform packet transmission after connection set-up, using still a special channel. As already mentioned earlier, the average transmission power of a special channel is the same as that of a normal carrier. An embodiment involves using in connection set-up a special channel, e.g. a special PRACH channel, only for an uplink connection and performing the signalling needed for a downlink connection on a normal channel, such as a PAGCH channel. This is possible because after having received a request for connection set-up from the subscriber terminal 102, the network part 100 knows its location and thus the network part 100 can use a directional antenna beam in its transmissions to the subscriber terminal 102.

Connection set-up here refers also to the control operations that are performed during a connection. Between successive packets of one and the same user the location of a user terminal 102 can change so essentially that previous data about the direction of the antenna beam can no longer be used for a successful packet transmission. This again calls for a method of the

invention whereby the direction of the subscriber terminal 102 in relation to a transceiver in the network part 100 can be detected.

Let us now examine Figure 3. The Figure shows one 51-multiframe of the GSM system using the packet radio system. In the time slot 0 is transmitted a RACH channel. Time slots 1 - 7 are dedicated channels. A traffic channel in the time slot 2 is dedicated for the use of the packet radio system, for transmitting a PRACH channel. In accordance with the invention, a special channel is established as shown in Figure 4. The contents of the time slots 0, 1, 3, 4, 5, 6 and 7 has been left out to be transmitted on another, normal carrier. The PRACH channel is spread in the time domain over all time slots, because now the channel's frequency band is made narrower and its data transmission rate slower, in the above described way. A corresponding operation is naturally performed on a downlink connection.

In accordance with the invention, coding ensuring high gain is performed on a special channel. This coding ensures that at the time of connection set-up the special channel can be received, even with errors included, beyond the range of a normal channel and, because of efficient error correction coding and interleaving, the originally transmitted information can be correctly decoded. For instance in a packet radio system using the CDMA (Code Division Multiple Access) technology a special channel is spread with its own spreading code and coded efficiently. In the CDMA system a user's narrowband data signal is multiplied by a spreading code of a considerably broader band than the data signal to a relatively broad band. Multiplying the data signal spreads it over the entire band used. Each connection between a network part and a subscriber terminal has its own spreading code, which allows the signals of the users to be distinguished from one another in the receivers on the basis of each user's spreading code. Each user can thus transmit simultaneously on the same frequency band. Another option is to transmit less information on the special channel, whereby the spreading ratio becomes more advantageous, ensuring thus error-free receipt of the transmitted information. The described more efficient coding and reduced amount of transmitted information naturally function also in other multiple access systems (such as FDMA, TDMA) and in their different combinations.

A special channel of the invention can also be established by combining different methods for making the range of the special channel longer than normally. For instance combining the increasing of transmission

power known per se, the described more efficient coding and the changing of bandwidth thus provides a solution according to the invention. The combination best suited to the prevailing circumstances is selected.

Let us now examine Figure 5, which illustrates an example of how the arrangements required by the invention can be performed. According to Figure 1, the essential parts of the system are the network part 100 and the subscriber terminal 102, with the intermediate radio connection 104. The network part 100 comprises a base station, a base station controller and a mobile switching centre. Let us examine Figure 5 which describes, by way of example, how the system is arranged to perform the necessary processing. The base station controller 500 is in contact with the base station 510. The base station controller 500 comprises a group switching network 502, a transcoder 504 and a control unit 506. The group switching network 502 is used for the switching of speech, data and packets and for connecting signalling circuits. The transcoder 504 converts different digital forms of speech coding used between a public switched telephone network and a mobile telephone network to be compatible. The control unit 506 performs call controlling, mobility management, collection of statistical data and signalling. The base station 510 comprises a frame unit 512, a frequency hopping unit 514, a carrier unit 516 and an antenna 518. In the frame unit 512 is performed channel coding, channel interleaving, data encryption and burst generating. In the frequency hopping unit 514 is optionally performed frequency hopping to a base band carrier. In the carrier unit 516 is performed modulation and A/D conversion of a transmitted signal. The subscriber terminal 102 comprises an antenna 520, a duplex filter 522, a transmitter 524 and a control part 526. The transmitter 524 comprises a modulator 530, a channel coder 532, an encrypter 534 and a source coder 536.

The base station controller 500 establishes a connection to the subscriber terminal 102 by requesting the base station 510 to send the subscriber terminal 102 a message, e.g. in the GSM system on a PPCH channel, for the connection set-up. In the carrier unit 516 is generated a carrier containing special channels, said carrier being transmitted through the antenna 518 to the subscriber terminal 102. Correspondingly, the subscriber terminal 102 responds to the connection set-up message, e.g. in the GSM system on a PRACH channel. In the modulator 530 is generated a carrier containing special channels, said carrier being transmitted to the base station

510. This description does not include receivers of the base station 510 and the subscriber terminal 102, because they are not essential to this description. At its simplest the invention is implemented by converting the steps of the method of the invention to be performed by software. The software can then be arranged e.g. in the memory of the control part 506 of the base station controller 500. The control part 506 then signals to the base station 510 to ensure that in the frame unit 512 the data needed will be arranged to the transmitted channel. To the carrier unit 516 is also signalled at which frequency it has to transmit the special channel. The arrangement can also be implemented with general processors, signal processors or with discrete logic. The functions between the base station controller 500 and a base station can also be divided in another way within the spirit of the invention. The software in the subscriber terminal can be stored in the memory of the control part 526, the storage being performed in said control part 526. In this case the software controls the operation of the transmitter 524, and particularly its modulator 530. The arrangement can also be implemented with general processors, signal processors or with discrete logic.

Even though the invention is described above with reference to an example shown in the attached drawings, it is apparent that the invention is not restricted to it, but can vary in many ways within the inventive idea disclosed in the attached claims.

CLAIMS

1. A packet radio system using SDMA, said system comprising a network part (100), at least one subscriber terminal (102) and a duplex radio connection (104) between the network part (100) and a subscriber terminal (102), said duplex radio connection (104) being used for connection set-up and packet transmission, characterized in that for connection set-up the network part (100) is arranged to establish a special channel (210) with a significantly longer range than that of a normal channel (200).

2. A system according to claim 1, characterized in that the special channel (210) has a bit energy-to-noise ratio of about 5 - 12 dB better than the normal channel (200).

3. A system according to claim 1, characterized in that the data transmission capacity of the special channel (210) is about 1/16 - 1/3 of the data transmission capacity of the normal channel (200).

4. A system according to claim 1, characterized in that the average transmission power of the special channel (210) is the average transmission power of the normal channel (200).

5. A system according to claim 1, characterized in that the bandwidth of the special channel (210) is considerably narrower than the bandwidth of the normal channel (200), being about 1/16 - 1/3 of the bandwidth of the normal channel (200).

6. A system according to claim 1, characterized in that coding ensuring high gain is performed on the special channel (210).

7. A system according to claim 1, characterized in that the network part (100) is arranged to use the normal channel (200) for packet transmission after connection set-up.

8. A system according to claim 1, characterized in that the network part (100) is arranged to use the special channel (210) for packet transmission after connection set-up.

9. A packet radio system using SDMA, said system comprising a network part (100), at least one subscriber terminal (102) and a duplex radio connection (104) between the network part (100) and a subscriber terminal (102), said duplex radio connection (104) being used for connection set-up and packet transmission, characterized in that for connection set-up the subscriber terminal (102) is arranged to establish a special channel (210) with a significantly longer range than that of a normal channel (200).

10. A system according to claim 9, characterized in that the special channel (210) has a bit energy-to-noise ratio of about 5 - 12 dB better than the normal channel (200).

11. A system according to claim 9, characterized in that the data transmission capacity of the special channel (210) is about 1/16 - 1/3 of the data transmission capacity of the normal channel (200).

12. A system according to claim 9, characterized in that the average transmission power of the special channel (210) is the average transmission power of the normal channel (200).

13. A system according to claim 9, characterized in that the bandwidth of the special channel (210) is considerably narrower than the bandwidth of the normal channel (200), being about 1/16 - 1/3 of the bandwidth of the normal channel (200).

14. A system according to claim 9, characterized in that coding ensuring high gain is performed on the special channel (210).

15. A system according to claim 9, characterized in that the subscriber terminal (102) is arranged to use the normal channel (200) for packet transmission after connection set-up.

16. A system according to claim 9, characterized in that the subscriber terminal (102) is arranged to use the special channel (210) for packet transmission after connection set-up.

17. A method for establishing a channel in a packet radio system using SDMA, said packet radio system comprising a network part (100), at least one subscriber terminal (102) and a duplex radio connection (104) between the network part (100) and a subscriber terminal (102), said duplex radio connection (104) being used for connection set-up and packet transmission, characterized in that the method comprises a step:

A) for connection set-up a special channel (210) is established with a significantly longer range than that of a normal channel (200).

18. A method according to claim 17, characterized in that the special channel (210) has a bit energy-to-noise ratio of about 5 - 12 dB better than the normal channel (200).

19. A method according to claim 17, characterized in that the data transmission capacity of the special channel (210) is about 1/16 - 1/3 of the data transmission capacity of the normal channel (200).

20. A method according to claim 17, characterized in that

the average transmission power of the special channel (210) is the average transmission power of the normal channel (200).

21. A method according to claim 17, characterized in that the bandwidth of the special channel (210) is considerably narrower than the bandwidth of the normal channel (200), being about 1/16 - 1/3 of the bandwidth of the normal channel (200).

22. A method according to claim 17, characterized in that coding ensuring high gain is performed on the special channel (210).

23. A method according to claim 17, characterized in that the method further comprises the following step:

B) after connection set-up the special channel (210) is used for packet transmission.

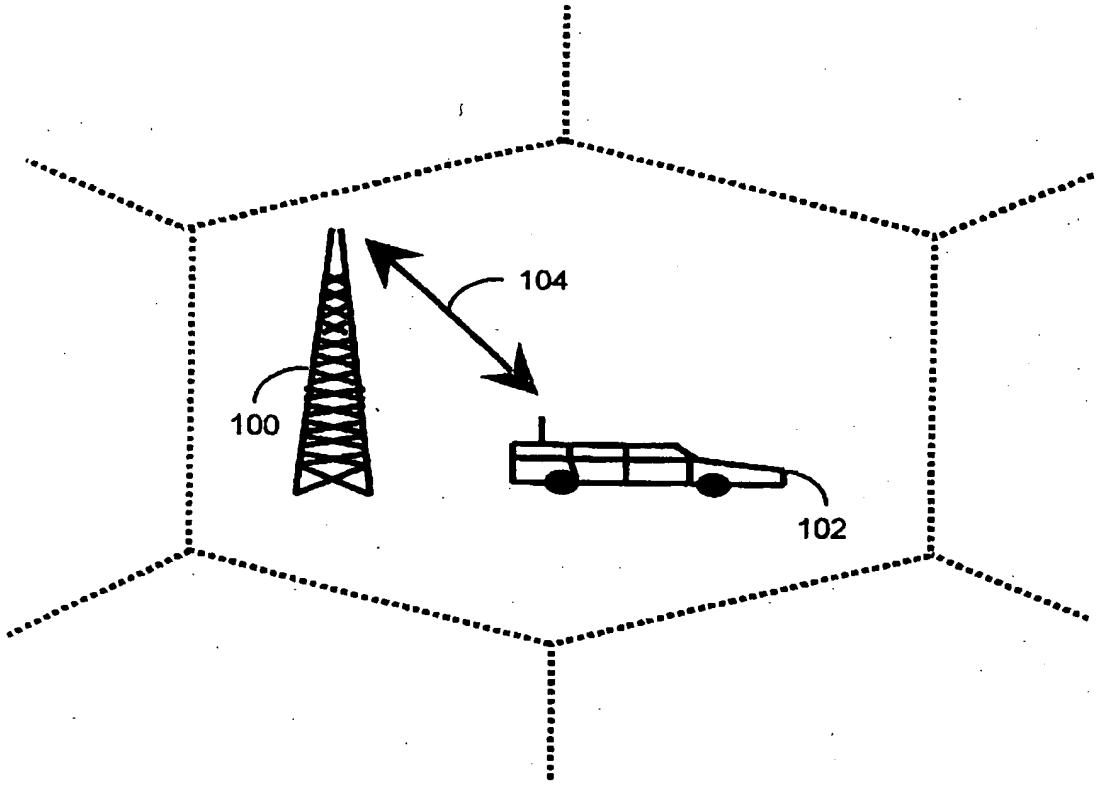

104
100
102

Fig 1

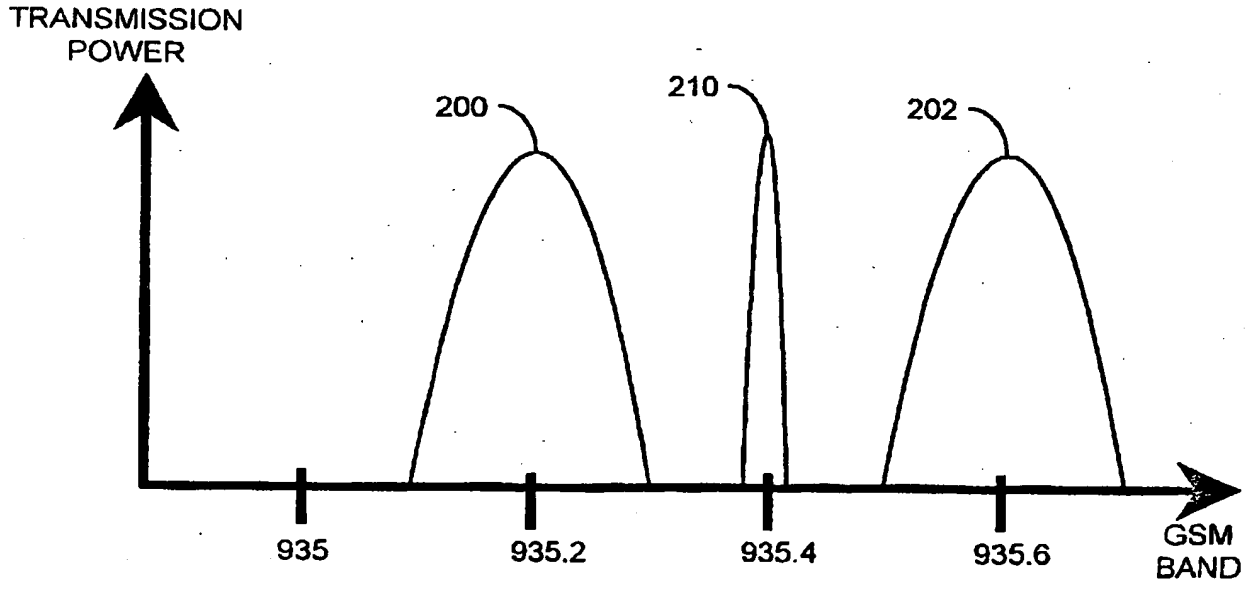

TRANSMISSION POWER
200
210
202
935
935.2
935.4
935.6
GSM BAND

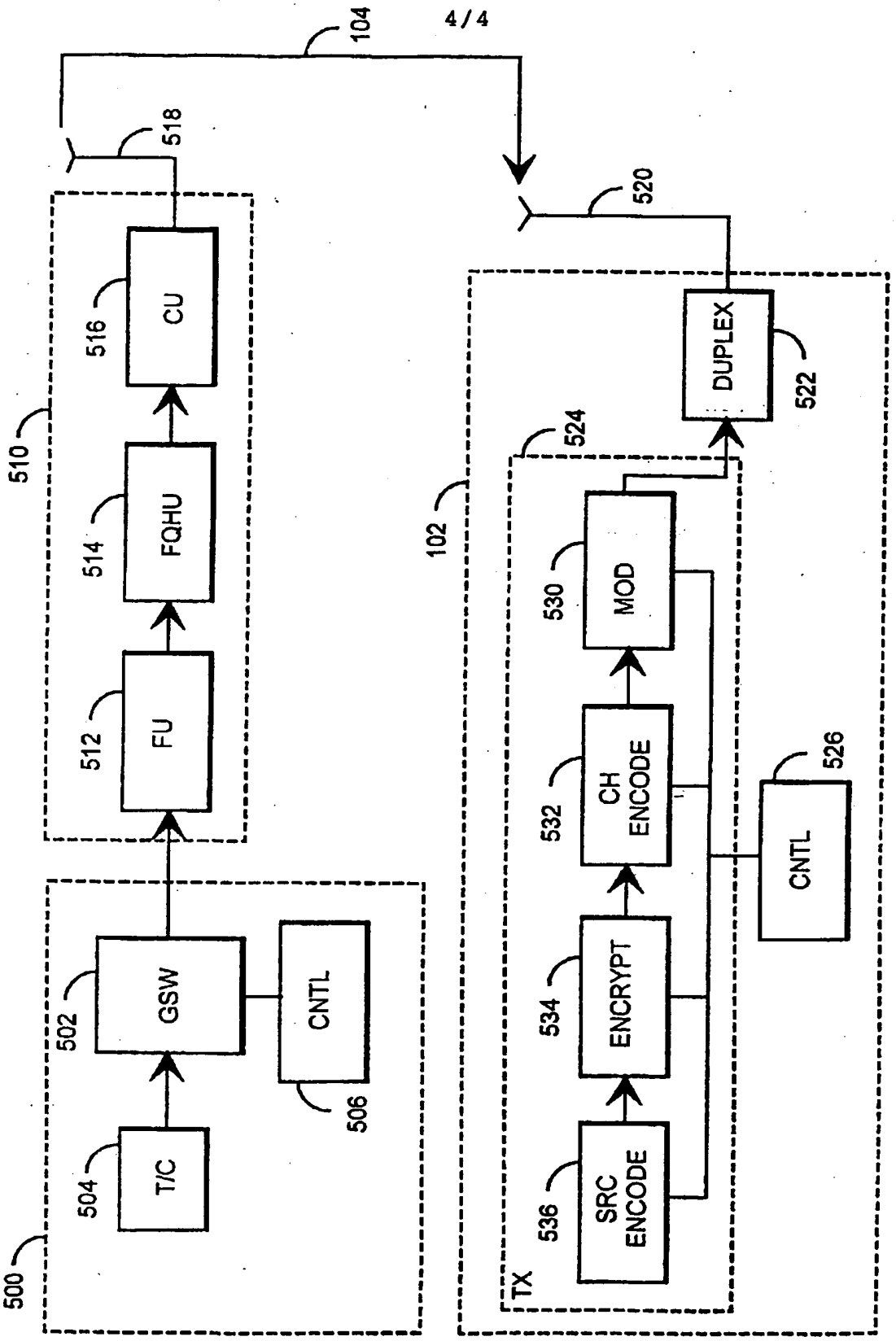
Fig 2

MULTIFRAME NUMBER	SLOT NUMBER OF THE TDMA-FRAME							
	0	1	2	3	4	5	6	7
50	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
49	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
32	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
31	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
30	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
29	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
28	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
27	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
26	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
25	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
24	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
23	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
22	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
21	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
20	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
19	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
18	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
17	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
16	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
15	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
14	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
13	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
12	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
11	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
10	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
9	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
8	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
7	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
6	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
5	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
4	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
3	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
2	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
1	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH
0	RACH	TCH	PRACH	TCH	TCH	TCH	TCH	TCH

Fig 3

MULTIFRAME NUMBER	SLOT NUMBER OF THE TDMA-FRAME							
	0	1	2	3	4	5	6	7
50	PRACH							
49	PRACH							
. .	.	.	.	.	.	.	.	.
32	PRACH							
31	PRACH							
30	PRACH							
29	PRACH							
28	PRACH							
27	PRACH							
26	PRACH							
25	PRACH							
24	PRACH							
23	PRACH							
22	PRACH							
21	PRACH							
20	PRACH							
19	PRACH							
18	PRACH							
17	PRACH							
16	PRACH							
15	PRACH							
14	PRACH							
13	PRACH							
12	PRACH							
11	PRACH							
10	PRACH							
9	PRACH							
8	PRACH							
7	PRACH							
6	PRACH							
5	PRACH							
4	PRACH							
3	PRACH							
2	PRACH							
1	PRACH							
0	PRACH							

Fig 4


104
518
520
516
CU
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514
FQHU
512
FU
502
GSW
CNTL
506
504
T/C
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102
DUPLEX
522
524
530
MOD
532
CH ENCODE
526
CNTL
534
ENCRYPT
536
SRC ENCODE
TX

Fig 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00814

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04B 7/26, H04Q 7/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04B, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0670640 A2 (TELIA AB), 6 Sept 1995 (06.09.95), column 2, line 46 - line 52; column 4, line 41 - line 57; column 5, line 8 - line 33 ---	1-23
Y	EP 0399610 A2 (PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED), 28 November 1990 (28.11.90), column 1, line 1 - column 2, line 26, abstract ---	1-23
A	WO 9637976 A1 (NOKIA TELECOMMUNICATIONS OY), 28 November 1996 (28.11.96), page 6, line 33 - page 7, line 7; page 16, line 1 - page 17, line 8; page 36, line 21 - line 27 ---	1,9,17

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"B" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 1998	04 -06- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Göran Petersson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00814

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

29/04/98

International application No.
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